Amendments to the Specification:

Please amend the specification by replacing paragraphs **[0006]**, **[0007]**, **[0025]**, **[0034]**, **[0038]**, **[0039]**, **[0045]**, **[0047]**, **[0048]**, **[0052]**, **[0053]**, **[0054]**, **[0055]**, **[0059]**, **[0060]**, **[0061]**, **[0063]**, **[0068]** and **[0069]** and the Abstract as follows:

[0006] Briefly stated, the present invention comprises an apparatus for enabling a person within a prescribed weight range to descend from an origin at a predetermined height in a multistory building to a lower supporting surface [at a sufficiently slow] and to attain a descent speed of less than four feet per second to land injury-free, the apparatus comprising a housing; a harness affixed to the housing for securely affixing the housing to the person; a cable within the housing of predetermined length sufficient to reach from the origin to the lower supporting surface, the cable having a free end which includes a securing member for attaching the free end to a fixed anchorage proximate the origin; and [an] a descent-slowing energy dissipating mechanism within the housing, driven by the play-out of the cable as the person descends, which enables the person to attain automatically within his descent a descent speed of less than four feet per second without the person's control determined by the intersection of the graph of the curve that describes [having the characteristic that the slope of] the rate of energy dissipated as a function of the descent speed and the graph of the line that describes [exceeds the slope of] the rate of potential energy released by the total descending weight as a function of the descent speed [at their point of intersection, and the characteristic that the intersection occurs at the sufficiently slow descent speed without the person's control] where the slope of the graph of the rate of energy dissipated curve exceeds the slope of the graph of potential energy released line.

[0007] The preferred embodiment is a self-contained apparatus that can be quickly put on over existing clothing. It has a helmet assembly that contains an air filtration system to provide breathable air to the person at least while he waits to egress the building. It then lowers him to the ground automatically on his own spool of high strength cable alongside the exterior of the building at an average speed of about one foot per second (1 ft/sec). Even at that extremely slow speed, it takes a mere twenty-four minutes to reach the ground from the highest occupied floor of either the Sears Tower in Chicago at 1,431 feet, or "Taipei 101" in Taiwan at 1,441 feet — the newest title holder for the world's highest occupied floor. After simple anchorages are installed on every floor, the present invention is well suited for the rapid and safe evacuation of *thousands* of persons from such tall buildings. In short, the present invention is an apparatus, for 1) providing a means for every person on every floor to quickly exit the deadly interior of a building regardless of the person's size or physical skills, while 2) still protecting them against smoke and other deadly gases while they wait to exit, then 3) providing them a slow, automatic descent to the ground alongside the exterior of the building regardless of the building's configuration or height, while 4) continuing to provide them protection against smoke, heat, and falling debris. The present apparatus (one per person) enables every trapped person to escape from the interior of the building in minutes, and be gently deposited on the ground totally unscathed less than a half-hour later even from the tallest building. Unlike enclosed chutes, there is no maximum height. And unlike parachutes, no minimum height. And unlike devices that require user control, there is complete safety without any prior training. Also, the same size apparatus is utilized for persons of all sizes and weights ranging from 60 pounds to 360 pounds.

[0025] First to be analyzed is ***not*** the present invention, but a device called the Safir-Rosetti ResQline[[™]], invented by M. Meller (US-2003/0070872A1 & US-2003/007873A1). It will be

useful to compare it to the present invention. It consists basically of a spool of steel cable long enough to reach the ground (one spool per person), and an energy dissipating fan permanently and securely mounted to the floor beneath the window from which several persons are to egress the building. The fan is enclosed in a frame with a protective screen. The frame supports a platform, which in use extends out the window. The person climbs out onto the platform prior to pushing off. But before he climbs onto the platform he affixes his spool to a shaft extension of the fan and attaches the free end of the cable to his harness. As he descends, the cable will play out and rotate the spool, driving the fan. Its four equally spaced flat vanes are oriented perpendicular to the rotational motion to resist that rotation and thus limit the descent speed. When the fan finally stops rotating, the next person removes the previous person's spool (with the end of the cable still attached), and stores it away safely before affixing his own spool and attaching his own cable to his harness and repeating the process.

[0034] The 100 pound person is seen to start out at 18.5 ft/sec at the initial 5 inch spool diameter, and end up as slow as 6.5 ft/sec as the spool runs down to the 2.5 inch diameter. The 200 pound person starts out at 26 ft/sec and ends up as slow as 9 ft/sec. And the 300 pound person starts out at 29 ft/sec and ends up as slow as 11 ft/sec. These values are in line with ResQline[[™]]'s published demonstration results, which seem to employ relatively slight subjects descending from only moderately tall buildings that probably require only a 5 inch spooled diameter at the start and 3 inches upon landing. During the descent in the ResQline[[™]] system, all the cable that is not still on the spool is descending along with the subject, and that adds to the weight of the subject. This slightly increases the speed at the end, especially for lighter subjects. Taking all these beginning and ending speeds into account, this

correlates with ResQline[[™]]'s use of a 15 ft/sec "average" descent velocity in all their evacuation calculations.

[0038] After having analyzed the ResQline[[™]] system, for which the average descent speed for all persons is a whopping 15 ft/sec, and where the energy dissipating fan is way too large to be worn, the claims of the present invention may appear far-fetched.

[0039] Yet, referring back to the section on understanding the physics, it was seen that dissipating a potential energy of 271,000 watt-seconds is required to bring a 200 lb man down safely from a height of 1,000 feet. That is an average 27,100 watts for 10 seconds, or 2,710 watts for 100 seconds, or 271 watts for 1,000 seconds. Notice that the longest times (i.e., the slowest descent speeds) require the smallest power dissipation. Thus, low power dissipation and low descent speed are not mutually exclusive. Indeed, the opposite is true. As a matter of fact, the previously suggested modification to increase the vane length of the ResQline[[™]] fan from 15 inches to 18 inches would not only have resulted in a 19% decrease in the descent speed but a 19% *decrease* in the power dissipated by the fan. *(Looking at* **FIG. 3**, *because the slope of the rate of the energy dissipated curve exceeds the slope of the rate of energy released line, the point of intersection — which defines the speed of descent* ***and*** *the power (the rate of energy) dissipated — moves downward,* ***not*** *upward, as the value of* "P" *in equation* **(1)** *is increased.)*

[0045] The maximum cable spool diameter at the beginning is now 6 inches, and the played-out spool diameter is 3.25 inches. The total length of cable is sufficient to extend from the highest occupied floor of the Sears Tower all the way to the ground. Because of the gearing, the fan rotates twenty times for every spool rotation — thereby making the descent speed one-twentieth of what it would be for the same fan speed as the ResQline[[™]] system (at like

spooled diameters). The following table gives the relationship between the new descent speeds (in ft/sec) and the fan RPMs for a spooled diameter of 6 inches remaining on the cable spool, and for a spooled diameter of 3.25 inches remaining:

	Fan RPM	
Descent Speed (ft/sec)	at 6 inch diameter	at 3.25 inch diameter
0.5	382	705
1.0	764	1,410
1.5	1,146	2,115
2.0	1,528	—
2.5	1,910	—

[0047] **FIG. 5** shows the superposition of these curves with the previously calculated lines representing the rates of potential energy released as a function of descent speed for the 100 lb, the 200 lb, the 300 lb, and the 400 lb descending weights. As before, the intersections determine the maximum descent speeds at the beginning with a full spool, and the minimum descent speeds at the end with a depleted spool. But now unlike the ResQline[[™]] system, the weight of the cable no longer remaining on the spool is *subtracted* from the initial total weight because it is no longer descending. This causes an additional slight slowing effect near the end, which will be most apparent for the lightest people.

[0048] Even with the smaller energy dissipating fan, a total weight of 400 pounds (a 360 pound person with a backpack of up to 40 pounds of cable and other equipment) descends at the very slow speed of 1.9 ft/sec initially (power dissipation less than 1,200 watts), then slows to as little as 0.8 ft/sec at the end. *Compare this to ResQline*[[™]]*, where a 300 lb weight descends at 29 ft/sec initially, (power dissipation nearly 12,000 watts).*

[0052] It has been stated (but not yet demonstrated) that the intersection of the line describing the rate of potential energy released vs. the descent speed, with the curve describing the rate of energy dissipated vs. descent speed, indicates the actual descent speed. Yet it's straightforward to show. Looking at **FIG. 5**, the potential energy released line for a 200 lb descending weight is seen to intersect the rate of energy dissipated curve for the 6 inch spool diameter at a descent speed of 1.35 ft/sec, showing that 366 watts is released, and 366 watts is dissipated. If a transient pushes the descent speed a bit higher, say to 1.40 ft/sec, then 379 watts is released while 400 watts is dissipated. And so the 200 lb weight slows down ...down to exactly 1.35 ft/sec. Conversely, if a transient pushes the descent speed a bit lower, say to 1.30 ft/sec, then 352 watts is released, while only 335 watts is dissipated. And so the 200 lb weight speeds up ...to exactly 1.35 ft/sec. As the cable plays out and the spooled diameter reduces, the dissipation curve moves to the left causing the descent speed to move lower along the fixed slope of the potential energy released line for the given weight. (Not taking into account the slight reduction in weight as the cable plays-out and no longer descends — or the slight increase in weight for the ResQline[[™]] system, as the played-out cable now does descend.)

[0053] The above illustrates one of the basic principles of the present invention, that stable descent speeds will result when the slope of the curve describing the rate of energy dissipated

(the power) **exceeds** the slope of the line describing the rate of potential energy released at their point of intersection. It is not sufficient that the rate of energy dissipated (the power) merely increase proportionally with increasing descent speed. Both the present invention and the ResQline[[™]] system are seen to exhibit stable descent speeds.

Mass Evacuation with the ResQline[[™]] System

[0054] The ResQline[[™]] system's descent speeds are so high that any contact with the building during the descent will likely cause injury. Even their reduced landing speed of 10 ft/sec is like jumping from a two-foot platform. That's enough to break an ankle if the landing is not performed correctly. And compounding that problem, if the person falls or fails to immediately run forward upon landing, he may become ensnared in the remaining cable that continues to play down around him. However, ResQline[[™]] cannot reduce their descent speeds and still maintain a reasonable evacuation rate. In order to help avoid contact with the building during the descent, they provide a "push-off" platform that extends out from the building.

[0055] However, that may have limited effectiveness as shown by the following: Assume one is on the 70th floor of the 102 story Empire State building. About 240 people work on that floor. There are 20 windows on the north and south sides, and 14 windows on the east and west sides. Now assume there are eight ResQline[[™]] systems pre-installed at eight egress windows, two on each side. Egress windows are windows that can be easily opened in an emergency. If eight ResQline[[™]] systems and eight egress windows are installed on every floor of the building, then each system on the 70th floor will have at least one system and probably two directly above it and at least two systems and probably four directly below it. So although the

platforms reduce the chance of hitting the side of the building, they virtually guarantee hitting another platform which is just as dangerous (if not more so).

[0059] And there's an additional problem. Some tall buildings are tapered (like the Transamerica building and the John Hancock Center). Many more are stepped (like the Sears Tower). The ResQline[[™]] system is unable to cope with tapered buildings, and also unable to cope with stepped buildings because the cable continues to play out after the person has landed ...on the ground, or on a stepped lower rooftop level still several stories above the ground. As a result, if the unfortunate person were to try to continue his descent from the lower level, he would free-fall several stories, possibly to his death.

Mass Evacuation with the Present Invention

[0060] By contrast, the present invention successfully solves all of the above problems. As was done with the ResQline[[™]] system, it will be desirable to install egress windows on each floor. This avoids having to break the windows, which is dangerous for both the people doing the breaking and certainly for the people below. As in the previous Empire State building example, there would be eight egress windows on the 70th floor, two on each side. Alongside each egress window would be an anchor box supported by a steel chain capable of supporting up to 20 tons of weight. The top of the chain will have been previously secured to the I-beam girder above the window, or a similarly strong support.

[0061] As before, the two egress windows on the windward side of the building (the side with no smoke and fire) will be used (as directed by the fire chief at the site), and 120 people will exit from each window. But this time, they just clip their caribiners to the anchor box (their carabiners are affixed to the end of their spooled cables in their already donned backpacks) and

lower themselves out the window, one after the other as quickly as they can. That process should take no more than 15 seconds per person. That's 120 people in 30 minutes. (Versus 4 hours for the ResQline[[™]] system.)

[0063] Outside the building, the scene is one of hundreds, even thousands of people (from all the floors) being gradually and safely lowered down the side of the building. Their descent speeds are all under 2 ft/sec, typically differing from each other by less than 1 foot/sec. That means it takes more than 5 seconds for one person to pass another. As they slowly pass, they can easily fend each other off (even a kick in the head is no problem because of the helmets). Any projections from the building (including the open egress windows) are easily maneuvered around. And should a cable become snagged, twisted, or even totally wrapped around other cables in the process, it is not a problem. For unlike the ResQline[[™]] system, the already played-out cables in the present invention are not moving.

[0068] The backpack assembly **1** contains a cable spool **4**, pre-wound with a full length of steel cable **5**, an eight-vaned semi-cylindrical fan **6**, all of the associated bearings, gears, and shafts (not visible in this figure), a de-slacker spring **7**, a cable guide **8**, and a carabiner **9** affixed to the free end of cable **5**. The backpack assembly **1** is contained in a thin, aluminum or hard plastic casing **10**, with a grillwork portion **11** that surrounds the fan **6**. And to relieve any possible pressure points, a full-coverage memory-foam pad **12** is affixed to the user side of the backpack assembly **1**. Eight attachment ropes **13** are also affixed to the backpack assembly **1**, and secure it to the rescue support loop **14** of the rescue harness **2**. Each is fitted with a tensioning device **15** that once tightened, keeps the ropes taught and the backpack assembly **1** secure prior to the descent, and the person secure during the descent. (Belts, bungees, buckles, straps, clips,

tethers, rings, snaps, loops, ties, hook and loop material such as Velcro[[®]], and more may be used instead of the ropes and tensioning devices.)

[0069] The rescue harness **2** is a standard item that is readily available. The Yates Rescue Harness Model 310 and the CMC Tactical Rappel Harness are two acceptable examples. Both are one-size fits-all and the leg straps and waist straps are easily attached. Because of the leg straps, women would be encouraged to keep a pair of slacks available. Failing that, the rescue harness **2** can be put on beneath a skirt or a dress, and the rescue support loop **14** can be brought out at the top of the skirt or through the front of the dress. *(The same issue would exist with the ResQline*[[™]] *harness, or with rescue parachutes.)*

ABSTRACT OF THE DISCLOSURE

An apparatus for safely evacuating a person <u>within a prescribed weight range</u> from a multistory building by enabling the person to exit from the interior of the building to the outside very quickly and to descend to the ground or lower surface alongside the exterior of the building [sufficiently slowly] to <u>attain a descent speed of less than four feet per second to</u> land injury-free, the apparatus comprising a housing, a harness <u>affixed to the housing</u> for affixing the housing to the person, a cable of predetermined length within the housing, having a free-end with a securing member for affixing it to an anchorage proximate the descent point, and [having an] <u>a descent slowing</u> energy dissipating mechanism within the housing driven by the playout of the cable as the person descends, [having the characteristic that the slope of] <u>which enables the person to attain automatically within his descent a descent speed of less than four feet per second determined by the intersection of the graph of the curve that describes</u> the rate of energy

dissipated [exceeds the slope of] as a function of the descent speed and the graph of the line that describes the rate of potential energy released by the total descending weight as a function of descent speed where the slope of the graph of the rate of energy dissipated curve exceeds the slope of the graph of the rate of potential energy released line [at their point of intersection, and the characteristic that the intersection occurs at the sufficiently slow descent speed without the person's control].